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GB 2307092 A GB 2297212 A US 5502810 A
US 5500756 A US 5440418 A

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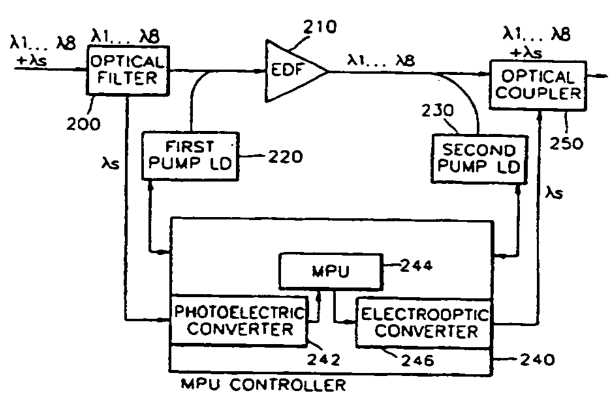
ONLINE: WPI

(54) Abstract Title

Using a supervision signal to control an amplifier to obtain even gain with respect to wavelength

(57) Wavelength division multiplexed optical amplifier controlling system and method are provided. The wavelength division multiplexed optical amplifier controlling system includes an optical exchange system for generating and interpreting a supervision channel optical signal, multiplexing the supervision channel and data channels comprised of a plurality of optical signals having different wavelengths, and transmitting and receiving the multiplexed channels and a plurality of optical amplifying portions located on a transmission path connected to the optical exchange system, for performing amplification so as to have even gain with respect to predetermined wavelength range which the data channel optical signals have according to the supervision channel optical signal information, and inserting the state information thereof into the supervision channel when the optical exchange system requests the state information thereof. According to the present invention, since an optical filter in each wavelength for supervision in a WDM-EDFA because a supervision channel having a predetermined wavelength is used is not necessary, the structure of the WDM-EDFA becomes simpler. Therefore, it is possible to lower costs and there is no loss of optical signals which occurs by using a conventional optical demultiplexer.

FIG. 2



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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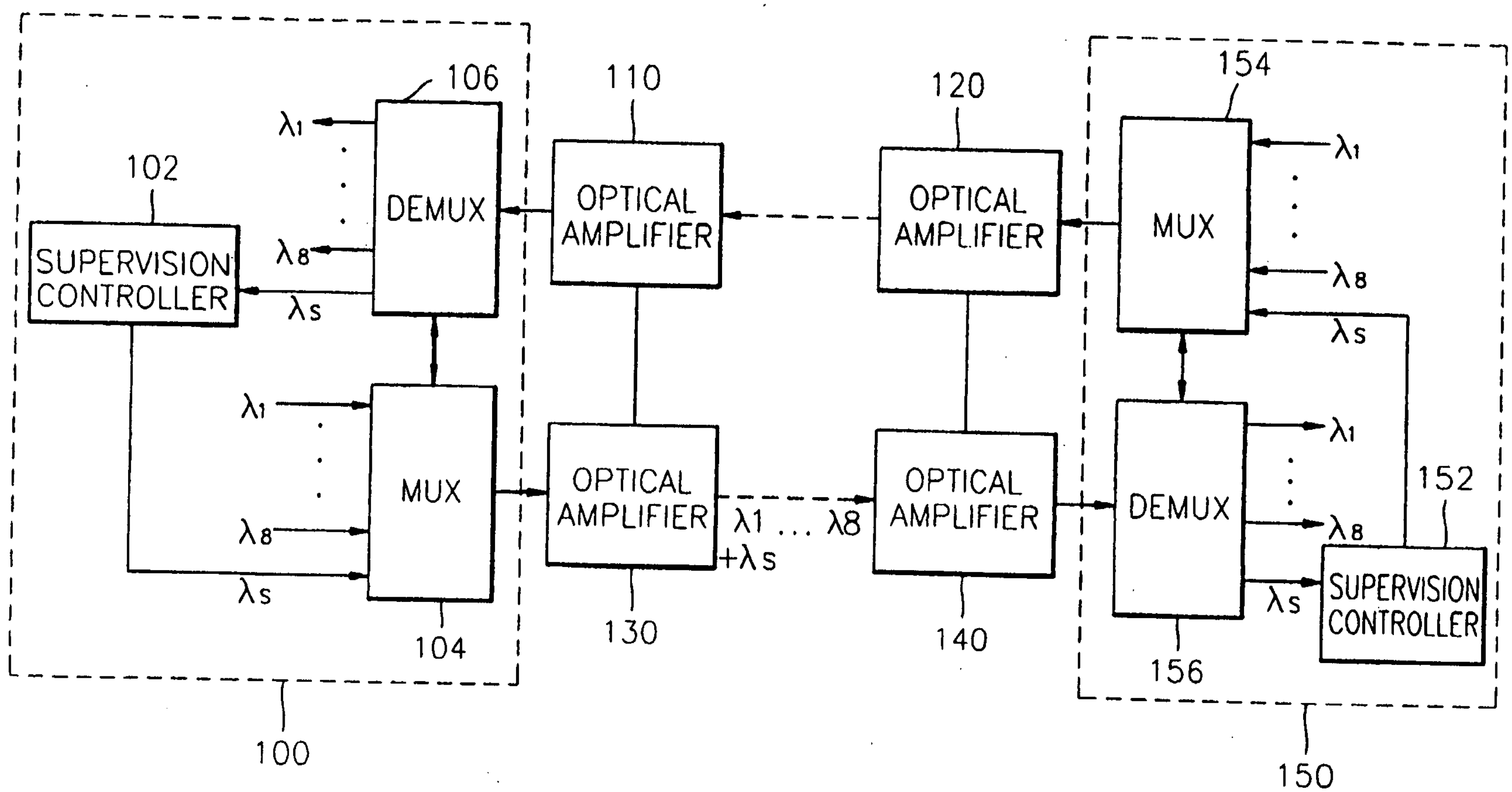
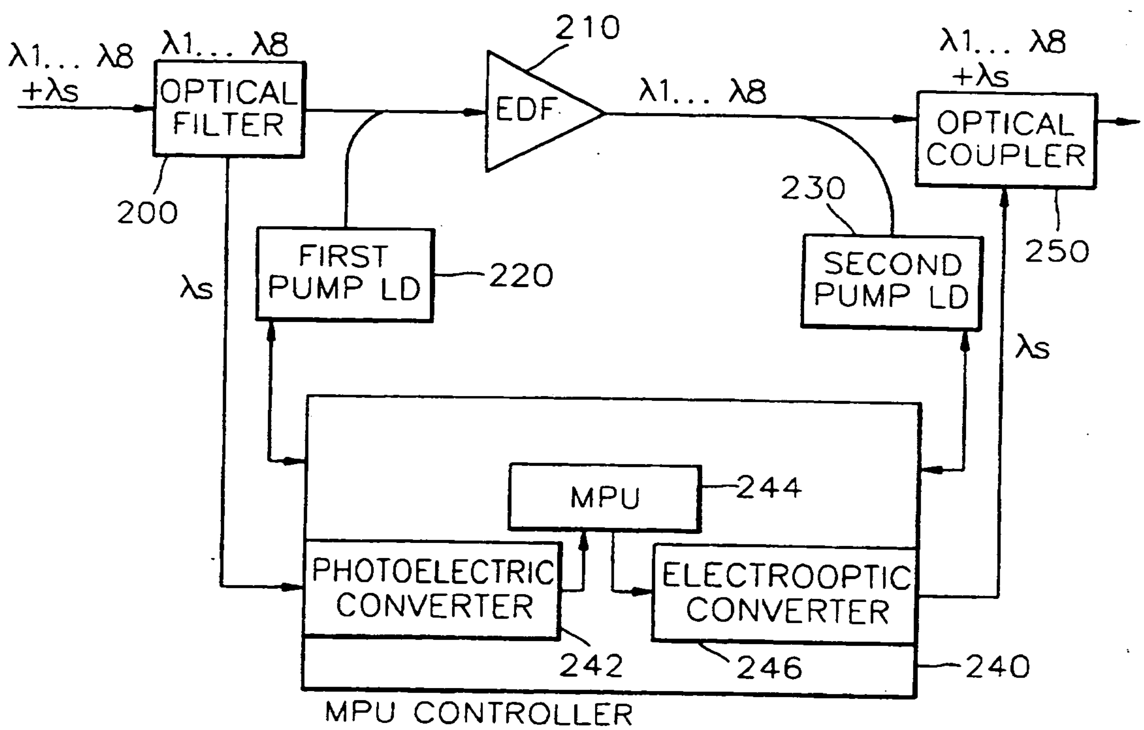
FIG. 1



100
102
SUPERVISION CONTROLLER
104
106
DEMUX
MUX
110
OPTICAL AMPLIFIER
120
OPTICAL AMPLIFIER
130
OPTICAL AMPLIFIER
140
OPTICAL AMPLIFIER
λ1 ... λ8 +λs
150
152
SUPERVISION CONTROLLER
154
MUX
156
DEMUX
λ1
λ8
λs

FIG. 2


λ1... λ8
+λs
λ1... λ8
OPTICAL
FILTER
200
λs
210
EDF
λ1... λ8
FIRST
PUMP LD
220
230
SECOND
PUMP LD
λ1... λ8
+λs
OPTICAL
COUPLER
250
λs
MPU
244
PHOTOELECTRIC
CONVERTER
242
ELECTROOPTIC
CONVERTER
246
240
MPU CONTROLLER

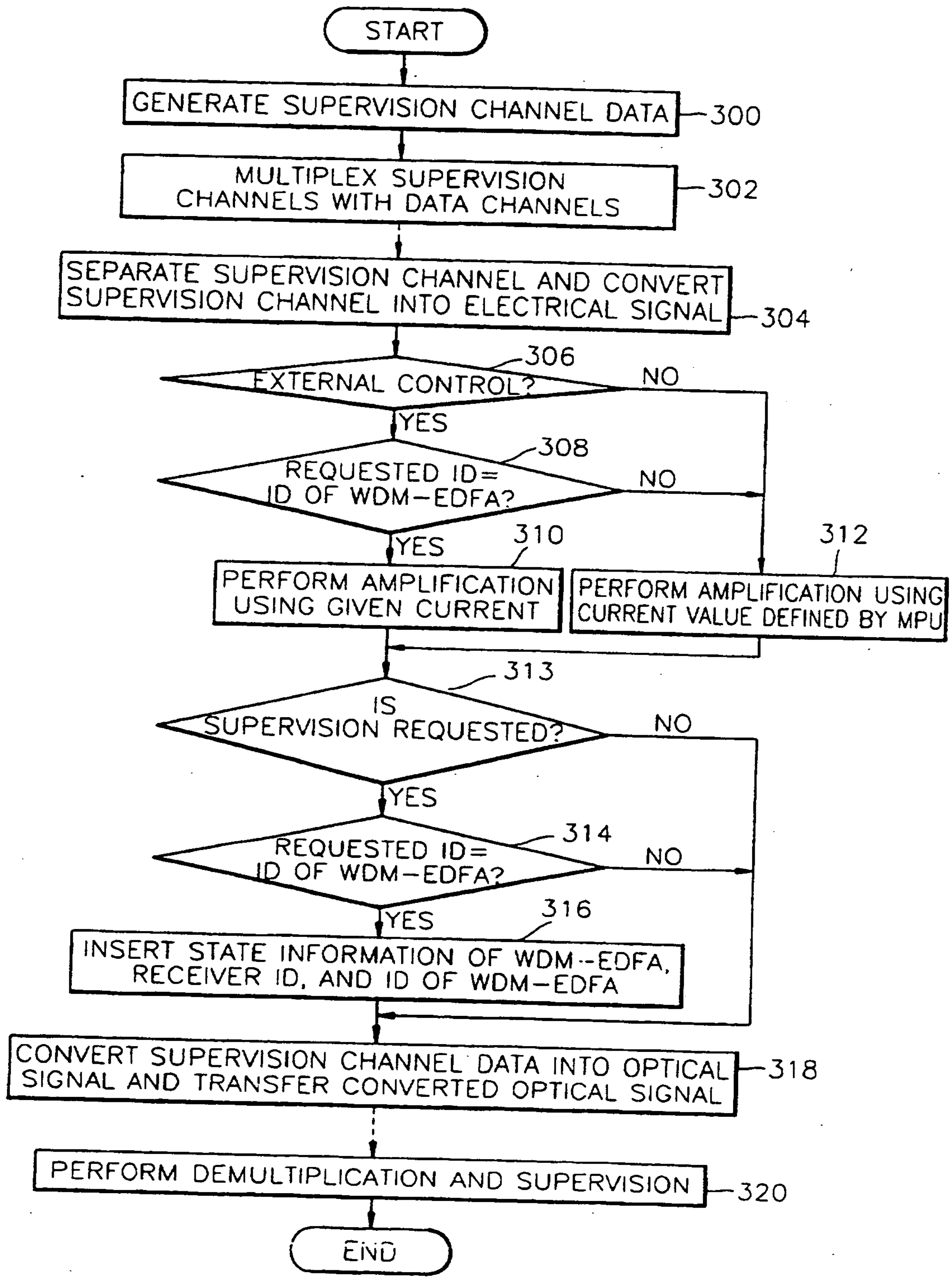
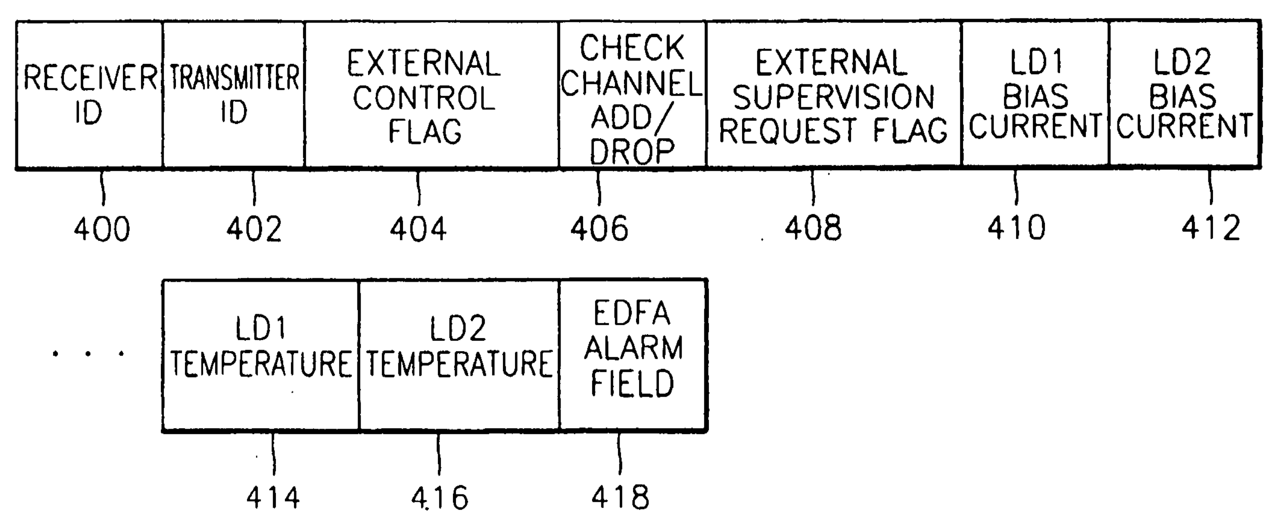

START
GENERATE SUPERVISION CHANNEL DATA
300
MULTIPLEX SUPERVISION CHANNELS WITH DATA CHANNELS
302
SEPARATE SUPERVISION CHANNEL AND CONVERT SUPERVISION CHANNEL INTO ELECTRICAL SIGNAL
304
306
EXTERNAL CONTROL?
NO
YES
308
REQUESTED ID= ID OF WDM-EDFA?
NO
YES
310
312
PERFORM AMPLIFICATION USING GIVEN CURRENT
PERFORM AMPLIFICATION USING CURRENT VALUE DEFINED BY MPU
313
IS SUPERVISION REQUESTED?
NO
YES
314
REQUESTED ID= ID OF WDM-EDFA?
NO
YES
316
INSERT STATE INFORMATION OF WDM--EDFA, RECEIVER ID, AND ID OF WDM-EDFA
CONVERT SUPERVISION CHANNEL DATA INTO OPTICAL SIGNAL AND TRANSFER CONVERTED OPTICAL SIGNAL
318
PERFORM DEMULTIPLICATION AND SUPERVISION
320
END

FIG. 3

FIG. 4


RECEIVER ID
TRANSMITTER ID
EXTERNAL CONTROL FLAG
CHECK CHANNEL ADD/ DROP
EXTERNAL SUPERVISION REQUEST FLAG
LD1 BIAS CURRENT
LD2 BIAS CURRENT
400
402
404
406
408
410
412
LD1 TEMPERATURE
LD2 TEMPERATURE
EDFA ALARM FIELD
414
416
418

2327309

SYSTEM OF CONTROLLING WAVELENGTH DIVISION MULTIPLEXED OPTICAL AMPLIFIER AND METHOD THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a system of controlling a wavelength division multiplexed optical amplifier and a method thereof, and more particularly, to a system of controlling a wavelength division multiplexed optical amplifier for supervising the state of the optical multiplexer and controlling an amplification factor using a supervising channel and a method for controlling thereof.

2. Description of the Related Art

With the development of the erbium doped fiber amplifier, a type of optical amplifiers, enormous growth in the optical transmission field was achieved. Also, with the development of a wavelength division multiplexed system which can transmit 4 through 16 channels at the same time as well as a single channel, came the development of a wavelength division multiplexed fiber amplifier (WDM-EDFA).

In general, in the WDM-EDFA, amplification gain must be uniformly maintained in each wavelength since more than four channels must be uniformly amplified at the same time, unlike the case of a single channel, and the current of a pump light source must be controlled so that there is little change in the amplification gain according to changes in the number of channels (add/drop).

In a conventional optical amplifier controlling system, the amplification gain is controlled by performing optical filtering on each wavelength or reading channel information sent from the supervising channel to a switching station or a relay station. However, the system structure becomes complicated in order to perform filtering on each wavelength. Accordingly, costs inevitably increase and the volume of the WDM-EDFA increases. Also, there is a technical problem in that filtering should be correctly performed for an interchannel space of 0.8nm.

To solve the above problem, the supervising channel multiplexed with data channels are extracted at the same time by an optical divider. The supervising channel is optically filtered from the extracted 10% of the signal and then examined. However, in such a case, 10% signal loss occurs and it becomes very difficult to input information on the state of the WDM-EDFA to the supervising channel. Namely, synchronization between the WDM-EDFA and a switching system, a multiplexer (MUX), and a demultiplexer (DEMUX) becomes necessary.

SUMMARY OF THE INVENTION

To solve the above problem(s), it is an objective of the present invention to provide a wavelength division multiplexed optical amplifier controlling system by which it is possible to transfer the state of an optical amplifier to a switching station or a relaying station through a supervising channel and to control the amplification gain of each optical amplifier.

It is another objective of the present invention to provide a system of controlling a wavelength division multiplexed optical amplifier by which it is possible to perform remote supervision and remote control through a shorter path by linking adjacent optical amplifiers and a method thereof.

To achieve the first objective, there is provided a wavelength division multiplexed optical amplifier controlling system, comprising an optical exchange system for generating and interpreting a supervision channel optical signal, multiplexing the supervision channel and data channels comprised of a plurality of optical signals having different wavelengths, and transmitting and receiving the multiplexed channels and a plurality of optical amplifying portions located on a transmission path connected to the optical exchange system, for performing amplification so as to have even gain with respect to predetermined wavelength range which the data channel optical signal have according to the supervision channel optical signal information, and inserting the state information thereof into the supervision channel when the optical exchange system requests the state information thereof.

To achieve the second objective, there is provided a method for controlling and supervising the optical amplifying portion in the optical exchange system in an optical communication system in which the optical exchange system and the optical amplifying portion are connected to the optical transmission path, using a supervision channel, comprising the steps of (a) multiplexing the supervision channel optical signal having a predetermined form and a data channel optical signal comprised of optical signals having different wavelengths in the optical exchange system and transmitting the multiplexed optical signals, (b) separating the supervision channel from the optical signals multiplexed in the step (a) at the optical amplifier and amplifying the data channel optical signal according to predetermined control information included in the separated supervision channel, (c) converting the state information of the optical amplifying portion into an optical signal, loading the converted optical signal into the supervision channel, combining the supervision channel with the data channel amplified in the step (b), and transmitting the combination result, and (d) demultiplexing the optical signal at the optical exchange system, and checking the state of the optical amplifying portion by interpreting the

supervision channel optical signal in the demultiplexed signal.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objectives and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIG. 1 is a block diagram of a wavelength division multiplexed optical amplifier controlling system;

FIG. 2 is a block diagram of the wavelength division multiplexed optical amplifier of FIG. 1;

FIG. 3 is a flowchart of a method of controlling a wavelength division multiplexed optical amplifier according to the present invention; and

FIG. 4 is a protocol form for controlling the wavelength division multiplexed optical amplifier.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, the present invention will be described in more detail with reference to the attached drawings. FIG. 1 is a block diagram of a wavelength division multiplexed optical amplifier controlling system according to the present invention. The controlling system shown in FIG. 1 includes a first optical exchange system 100, first, second, third, and fourth WDM-EDFAs 110, 120, 130, and 140, and a second optical exchange system 150. They are connected to each other by a bidirectional optical transmission line.

In a general optical communications system, the first optical exchange system 100 is separated from the second optical exchange system 150 by a distance of about 200km. The first and second optical exchange systems multiplex or demultiplex eight data channels having different wavelengths and a supervising channel, generates a supervising channel signal to be multiplexed, and interprets a divided supervising channel signal. The plurality of first, second, third, and fourth WDM-EDFAs 110, 120, 130, and 140 handle signal transmission bidirectionally between the first and second optical exchange systems 100 and 150 and control the amount of amplification thereof with reference to the data of the supervising channel. Also, when there is a request from the first optical exchange system 100 or the second optical exchange system 150, the WDM-EDFAs construct and transfer the supervising channel signals thereof. At this time, since the first and third WDM-EDFAs 110 and 130 and the second and fourth WDM-EDFAs 120 and 140 are linked to each other in order to shorten the signal path, one optical exchange

system can bidirectionally supervise and control all the amplifying portions.

The first and second optical exchange systems 100 and 150 include supervising and controlling portions 102 and 152, multiplexers (MUX) 104 and 154, and demultiplexers (DEMUX) 106 and 156, respectively.

The multiplexers (MUX) 104 and 154 multiplex data channels having eight different wavelengths and a supervising channel having a wavelength that is shorter than those of the data channels. The demultiplexers (DEMUX) 106 and 156 demultiplex the multiplexed optical signals. The supervising and controlling portions 102 and 152 supervise the respective WDM-EDFAs connected to the supervising channels of the MUXs 104 and 154 and the DEMUXs 106 and 156 or construct the supervising channels in order to control the amplification gains of the respective WDM-EDFAs.

FIG. 2 is a block diagram of the WDM-EDFAs 110, 120, 130, and 140. Each WDM-EDFA according to FIG. 2 includes an optical filter 200, an erbium doped fiber (EDF) 210 as an optical amplifier, first and second pump light sources 220 and 230 as driving portions the EDF 210, a micro processor unit (MPU) controller 240, and an optical coupler 250.

The optical filter 200 extracts the supervising channel from the multiplexed optical signal and transmits the optical signals of the remaining data channels. The EDF 210 amplifies the transmitted optical signals of the remaining data channels. The first and second pump light sources 220 and 230 generate pump light for amplifying the data channel optical signal at the EDF 210. The MPU controller 240 converts the supervising channel optical signal extracted by the optical filter 200 into an electrical signal and obtains data required for the amplification by the EDF 210. Current is provided to the first and second pump light sources 220 and 230 according to the data and various kinds of state information with respect to the EDF 210 are converted into the optical signals and are output. The optical coupler 250 combines the data channel optical signals amplified by the EDF 210 with the supervising channel optical signal of the MPU controller 240 and transmits the combination result.

The MPU controller 240 is comprised of a photoelectric converter 242 such as a photo diode, an MPU 244, and an electrooptic converter 246 such as a distributed feedback light source.

The photoelectric converter 242 converts the supervising channel optical signal into an electrical signal. The MPU 244 interprets the supervising channel signal converted into the electrical signal, controls the bias current of the first and second pump light sources 220 and 230 or constructs various kinds of state information of the first and second pump light sources 220 and 230 as the

supervising channel data. The electrooptic converter 246 converts the supervising channel data of the MPU 244 into an optical signal and outputs the conversion result.

The operation will be described with reference to FIGs. 3 and 4. FIG. 3 is a flow chart for illustrating a method of controlling the wavelength division multiplexed optical amplifier according to the present invention. FIG. 4 is a protocol form for controlling the WDM-EDFAs.

IDs are given to the first and second optical exchange systems 100 and 150 and the respective WDM-EDFAs 110, 120, 130, and 140. The supervising channel data having the protocol shown in FIG. 4 is generated in the MUX 104 or 154 of a transmission part of the first and second optical exchange systems 100 and 150 (step 300). The protocol has a form of a receiver port ID of eight bits 400, a transmitter port ID of eight bits 402, an external control flag of one bit 404, a channel add/drop checking field of eight bits 406, an external supervision request flag of one bit 408, first pump light source bias current 410, second pump light source bias current of eight bits 412, the temperature 414 of the first pump light source of eight bits, the temperature 416 of the second pump light source of eight bits, and a WDM-EDFA alarm field of six bits 418.

The transmitting and receiving ports IDs 400 and 402 show calling or called IDs. The external control flag 404 is set to be 1 by the optical exchange system when the amplification gain of an arbitrary WDM-EDFA is to be controlled. The channel add/drop checking field 406 indicates the respective channel presences among eight data channels. The external supervision request flag 408 shows whether there is a supervision request from the optical exchange system. When there is a supervision request, the external supervision request flag is set to be 1. The first and second pump light source bias currents 401 and 412 show the bias current values of the first and second pump light sources set from the outside in order to control the amplification gain of the WDM-EDFA. The temperatures of the first and second pump light sources show the temperatures of the first and second pump light sources which the WDM-EDFA inputs in order to supervise whether the WDM-EDFA is amplified from the outside. The WDM-EDFA alarm field 418 shows whether there is an input or output power supply error in the WDM-EDFA, current supply errors of the first and second pump light sources, and temperature sensing errors of the first and second pump light sources.

The supervision channels generated in the respective WDM-EDFAs are multiplexed with eight data channels through the MUX 104 or 154 and are transferred at a high speed (step 302). In the respective WDM-EDFAs 110, 120, 130, and 140 on an optical transmission path, the optical filter 200 extracts the

supervision channel optical signal from the multiplexed optical signals. The photoelectric converter 242 converts the supervision channel optical signal into an electrical signal (step 304). At this time, when an alarm (not shown) is connected to the output terminal of the photoelectric converter 242 as a supervisor of the optical transmission path, thus alarming when the output power of the photoelectric converter 242 is not less than a threshold value, it is possible to sense whether the optical transmission path normally operates.

The MPU 244 checks each field of the protocol from the electrical signal converted in the step 304. The check is performed as follows. When the external control flag 404 is 1 (step 306) and the receiver ID 400 is the same as the ID of the WDM-EDFA (step 308) which the MPU 244 belongs to the values of the bias current fields 410 and 412 of the first and second pump light sources are provided to the bias current values of the first and second pump light sources 220 and 230 (step 310). When the external control flag 404 is 0 or the receiver ID 400 is different from the ID of its WDM-EDFA, the current value determined in the MPU 244 supplied to the bias current value of the first and second pump light sources 220 and 230 (step 312). The first and second pump light sources 220 and 230 generate pumping light according to the supplied current value. The EDF 210 amplifies the data channel optical signal which has passed through the optical filter 200 so as to have an even gain with respect to each wavelength by the pumping light.

After the amplification, the external supervision request flag of the protocol is checked (step 313). Namely, when the external supervision request flag 408 is 1 and the receiver ID 400 is the same as the ID of the WDM-EDFA which the MPU 244 belongs to (step 314), the state information of that WDM-EDFA, i.e., the values of the temperature fields 414 and 416 of the first and second pump light sources and that WDM-EDFA alarm field 418 are set and the ID of the location requesting the external supervision and the ID of that WDM-EDFA are respectively input to the receiver ID field 400 and the transmitter ID field 402 (step 316). The electrooptic converter 246 converts the set supervision channel data into the optical signal. When the external supervision flag 408 is 0 or the receiver ID 400 is different from the ID of that WDM-EDFA, the above-mentioned protocol data is converted into the optical signal through the electrooptic converter 246 without change.

The optical coupler 250 combines the supervision channel converted into the optical signal with the data channel optical signal amplified by the EDF 210. When there are more WDM-EDFAs on the optical transmission path, the above-mentioned processes are repeated. The data channel optical signal is amplified and the supervision channel optical signal is added to the data channel optical signal, which

reaches the optical exchange system 100 or 150.

The DEMUX 106 or 156 in the optical exchange system 100 or 150 demultiplexes the multiplexed data channel optical signal and the supervision channel optical signal. The supervision controlling portion 102 or 152 connected to the supervision channel interprets the supervision channel optical signal and supervises the state of each WDM-EDFA (step 320).

According to the present invention, the structure of the WDM-EDFA becomes simpler by using the supervision channel since an optical filter per each wavelength for supervision in the WDM-EDFA is not necessary. Therefore, it is possible to lower costs and there is no loss in the optical signal which occurs by using a conventional optical demultiplexer. Also, since the amplification is not necessary in a supervision channel band by separating only the supervision channel, processing the supervision channel, converting the supervision channel into the optical signal, and combining the converted optical signal into the optical transmission path, it is possible to ease the burden of flattening the amplification gain of supervision channel band as well as data channel band at the WDM-EDFA and to easily combine the state information of the WDM-EDFA into the optical transmission path. Accordingly, remote supervision and remote control can be performed. Also, since gain control is perfomed by sending channel add/drop information to the supervision channel, it is possible to compensate for the time error of the gain control according to the change of channels by the optical exchange system. Accordingly, it is easier to supervise, maintain, and repair IN-LINE WDM-EDFA in an optical communications system.

What is claimed is:

1. A wavelength division multiplexed optical amplifier controlling system, comprising:

an optical exchange system for generating and interpreting a supervision channel optical signal, multiplexing the supervision channel and data channels comprised of a plurality of optical signals having different wavelengths, and transmitting and receiving the multiplexed channels; and

a plurality of optical amplifying portions located on a transmission path connected to the optical exchange system, for performing amplification so as to have even gain with respect to predetermined wavelength range which the data channel optical signals have according to the supervision channel optical signal information, and inserting the state information thereof into the supervision channel when the optical exchange system requests the state information thereof.

2. The wavelength division multiplexed optical amplifier controlling system of claim 1, wherein the optical exchange system comprises:

a multiplexer for multiplexing data channels comprised of the optical signals having different wavelengths and the supervision channel;

a demultiplexer for demultiplexing the multiplexed optical signal into the data channel optical signal having different wavelengths and the supervision channel; and

a supervision controller for generating the supervision channel optical signal and interpreting the supervision channel Iptical signal demultiplexed by the demultiplexer.

3. The wavelength division multiplexed optical amplifier controlling system of claim 2, wherein the optical amplifying portion comprises:

an optical filter for transmitting the data channel optical signal from the output optical signal of the multiplexer and extracting the supervision channel optical signal;

an optical amplifier for amplifying the data channel optical signal which passed through the optical filter;

a driving portion for controlling the gain of the optical amplifier;

a controlling portion for converting the supervision channel optical signal extracted by the optical filter into an electrical signal, controlling the driving portion so as to have even gain with respect to each data channel wavelength using the data included in the electrical signal, and converting the state information of the driving portion into the optical signal when there is request of the supervision

controlling portion; and

an optical coupler for combining the data channel optical signal amplified by the optical amplifier with the supervision channel optical signal output from the controlling portion.

4. The wavelength division multiplexed amplifier controlling system of claim 3, wherein the optical amplifier is an erbium added fiber amplifier.

5. The wavelength division multiplexed amplifier controlling system of claim 3, wherein the driving portion is comprised of two light sources which generate pump light according to current values included in data converted into an electrical signal by the controlling portion.

6. The wavelength division multiplexed optical amplifier controlling system of claim 3, wherein the controlling portion comprises:

a photoelectric converter for converting the supervision channel optical signal extracted by the optical filter into an electrical signal;

a microprocessor for interpreting the output electrical signal of the photoelectric converter and outputting as a control signal or constructing data required for supervision and outputting the data; and

an electrooptic converter for converting predetermined data output from the microprocessor into an optical signal.

7. The wavelength division multiplexed optical amplifier controlling system of claim 6, further comprising an optical transmission path supervisor which is connected to the electrooptic converter and operates when electrical signal power converted by the electrooptic converter is not less than a predetermined value, for displaying that the optical transmission path normally operates.

8. A method for controlling and supervising the optical amplifying portion in the optical exchange system in an optical communication system in which the optical exchange system and the optical amplifying portion are connected to the optical transmission path, using a supervision channel, comprising the steps of:

(a) multiplexing the supervision channel optical signal having a predetermined form and a data channel optical signal comprised of optical signals having different wavelengths in the optical exchange system and transmitting the multiplexed optical signals;

(b) separating the supervision channel from the optical signals multiplexed in

the step (a) at the optical amplifier and amplifying the data channel optical signal according to predetermined control information included in the separated supervision channel;

(c) converting the state information of the optical amplifying portion into an optical signal, loading the converted optical signal into the supervision channel, combining the supervision channel with the data channel amplified in the step (b), and transmitting the combination result; and

(d) demultiplexing the optical signal at the optical exchange system and checking the state of the optical amplifying portion by interpreting the supervision channel optical signal in the demultiplexed signal.

9. The method of claim 8, wherein, when there exist a plurality of optical amplifying portions, the respective amplifying portions repeat the steps (b) and (c).

10. The method of claim 8, wherein, when the optical exchange system does not supervise but controls the amplifying portion, the supervision channel data comprises:

a transmitter ID field showing the ID of a device for forming supervision channel data;

a receiver ID field showing the ID of a device which becomes an object of the formed supervision channel data;

a channel add or drop checking field showing the added or dropped channel having different waveforms in the data channel;

an external control flag set to show that the optical exchange system controls the amplification gain of the optical amplifying portion;

an external supervision request flag showing that the optical exchange system did not supervise the state of the optical amplifying portion; and

two fields having a predetermined value and a predetermined number of bits, for controlling the amplification gain of the amplifying portion.

11. The method of claim 8, wherein, when the optical exchange system does not control but supervises the amplifying portion, the supervision channel data comprises:

a transmitter ID showing the ID of a device for forming supervision channel data;

a receiver ID showing the ID of a device which becomes the object of the formed supervision channel data;

a channel add or drop checking field showing the added or dropped channel having different waveforms in the data channel;

an external control flag set to show that the optical exchange device does not control the amplification gain of the optical amplifying portion;

an external supervision request flag showing that the optical exchange device supervises the state of the optical amplifying portion; and

two fields having the state information of the optical amplifying portion and a predetermined number of bits.

12. The method of claim 11, wherein the optical amplifying portion controls the amplification gain thereof.

13. The method of claim 8, wherein, when the optical exchange system supervises and controls the amplifying portion, the supervision channel data comprises:

a transmitter ID showing the ID of a device for forming supervision channel data;

a receiver ID showing the ID of a device which becomes the object of the formed supervision channel data;

a channel add or drop checking field showing the added or dropped channel having different waveforms in the data channel;

an external control flag set to show that the optical exchange system controls the amplification gain of the optical amplifying portion;

an external supervision request flag showing that the optical exchange system supervises the state of the optical amplifying portion;

two fields having a value of controlling the amplification gain of the optical amplifying portion and a predetermined number of bits; and

two fields having the state information of the optical amplifying portion and a predetermined number of bits.

14. The method of claims 11 through 13, further comprising an alarm field having a predetermined number of bits showing whether necessary value are provided to the optical amplifying portion and whether the state of the optical amplifying portion is sensed.

15. A wavelength division multiplexed optical amplifier controlling system substantially as described with reference to the accompanying drawings.

16. A method for controlling and supervising the optical amplifying portion in the optical exchange system in an optical communication system substantially as described with reference to the accompanying drawings.

The Patent Office

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Application No: GB 9815316.6
Claims searched: 1-16

Examiner: Stephen Brown
Date of search: 30 October 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4B (BK16, BK16D, BKX)

Int Cl (Ed.6): H04B: 10/16, 10/17, H04J: 14/02.

Other: Online : WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2 307 092 A	(Hitachi) See especially the abstract & figure 7.	1, 2
X, Y	GB 2 297 212 A	(Fujitsu) See especially the abstract, figure 16, and page 39, line 21, onwards.	X: 8 Y: 1, 2
A	US 5 502 810	(NEC)	-
X, Y	US 5 500 756	(Hitachi) See especially the abstract, figure 1, figure 24, and column 31, lines 10-16.	X: 8 Y: 1, 2
X, Y	US 5 440 418	(Oki Electric) See especially the abstract.	X: 8, 9 Y: 1, 2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		

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